



- AEC-Q200 Compliance
- Small size and light weight
- Highly reliable multilayer electrode construction
- Compatible with all soldering processes
- 100% CCD inspection
- This specification applies to all rectangular sizes of fixed chip resistors with Ruthenium-base as material

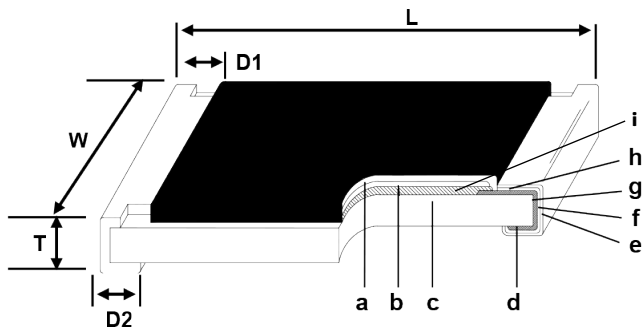


Applications

Automotive industry, telecommunication equipment, radio and tape recorders, TV tuners, digital cameras, watches, pocket calculators, computers, instruments and medical equipment

Construction

Fig. 1



a	Secondary overcoat	f	Barrier layer
b	Primary overcoat	g	Edge electrode
c	Alumina substrate	h	Top electrode
d	Bottom electrode	i	Resistor layer
e	External electrode		

Dimensions

Table 1

Size (inches)	L (mm)	W (mm)	T (mm)	D1 (mm)	D2 (mm)	Weight 1000pcs (g)
0201	0.60 ± 0.03	0.30 ± 0.03	0.23 ± 0.03	0.15 ± 0.05	0.15 ± 0.05	0.150
0402	1.00 ± 0.05	0.50 ± 0.05	0.35 ± 0.05	0.20 ± 0.10	0.20 ± 0.10	0.620
0603	1.60 ± 0.10	0.80 ± 0.10	0.45 ± 0.10	0.30 ± 0.20	0.30 ± 0.20	2.042
0805	2.00 ± 0.10	1.25 ± 0.10	0.50 ± 0.10	0.35 ± 0.20	0.40 ± 0.20	4.368
1206	3.10 ± 0.10	1.55 ± 0.10	0.55 ± 0.10	0.50 ± 0.25	0.50 ± 0.20	8.947
1210	3.10 ± 0.10	2.60 ± 0.15	0.55 ± 0.10	0.50 ± 0.25	0.50 ± 0.20	15.959
2010	5.00 ± 0.10	2.50 ± 0.15	0.55 ± 0.10	0.60 ± 0.25	0.50 ± 0.20	24.241
2512	6.35 ± 0.10	3.10 ± 0.15	0.55 ± 0.10	0.60 ± 0.25	0.50 ± 0.20	39.448

Example Ordering Code

S T 0 1 - 0 6 0 3 - 1 0 0 K - B - H - D - A C

Series	Case	Resistance	Tolerance	Function Code	Packaging Code	Special Code
ST01	Size	Ω	± %	L: Standard & High Precision E: TC50 P: High Power H: Ultra High Power	0: 7" Reel 15K pcs 2: 7" Reel 2K pcs 4: 7" Reel 4K pcs 5: 7" Reel 20K pcs 6: 7" Reel 10K pcs 7: 7" Reel 5K pcs 9: 10" Reel 8K pcs A: 10" Reel 10K pcs B: 10" Reel 20K pcs C: 13" Reel 40K pcs D: 13" Reel 20K pcs	AC: 100% CCD inspection
	0201	0 (Jumper)	B: 0.1			
	0402	1R-100M	C: 0.25			
	0603		D: 0.5			
	0805		F: 1			
	1206		J: 5			
	1210					
	2010					
	2512					

Standard Electrical Specifications

Table 2

Size	Power rating at 70°C / Jumper rated current	Operating temp. range °C	Max. Operating voltage	Max. overload voltage	Resistance range		TCR ppm/°C
					±1% (E24 - E96)	± 5% (E24)	
0201	1/20W	-55 ~ +155	25V	50V	1Ω - 10MΩ		±200
	Jumper 1A				-	0Ω - (50MΩ)	-
0402	1/16W	-55 ~ +155	50V	100V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02Ω - 20MΩ 20.5Ω - 100MΩ		±200 ±100 ±200 ±400
	Jumper 1A				-	0Ω - (50MΩ)	-
0603	1/10W	-55 ~ +155	75V	150V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02Ω - 20MΩ 20.5Ω - 100MΩ		±200 ±100 ±200 ±400
	Jumper 1A				-	0Ω - (50MΩ)	-
0805	1/8W	-55 ~ +155	150V	300V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02Ω - 20MΩ 20.5Ω - 100MΩ		±200 ±100 ±200 ±400
	Jumper 2A				-	0Ω - (50MΩ)	-
1206	1/4W	-55 ~ +155	200V	400V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02Ω - 20MΩ 20.5Ω - 100MΩ		±200 ±100 ±200 ±400
	Jumper 2A				-	0Ω - (50MΩ)	-
1210	1/2W	-55 ~ +155	200V	400V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02Ω - 20MΩ 20.5Ω - 39MΩ		±200 ±100 ±200 ±400
	Jumper 2.5A				-	0Ω - (50MΩ)	-
2010	3/4W	-55 ~ +155	200V	400V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02Ω - 20MΩ 20.5Ω - 100MΩ		±200 ±100 ±200 ±400
	Jumper 3.5A				-	0Ω - (50MΩ)	-
2512	1W	-55 ~ +155	250V	500V	1Ω - 9.76Ω 10Ω - 1MΩ 1.02Ω - 20MΩ 20.5Ω - 100MΩ		±200 ±100 ±200 ±400
	Jumper 4A				-	0Ω - (50MΩ)	-

High Precision Electrical Specifications

Table 3

Size	Power rating at 70°C	Operating temp. range °C	Max. Operating voltage	Max. overload voltage	Resistance range (£24 - E96)				TCR ppm/°C
					± 0.1%	± 0.25%	± 0.5%	± 1%	
0402	1/16W	-55 ~ +155	50V	100V	-		10Ω - 1MΩ		±100
					-		1.02MΩ - 10MΩ		±200
0603	1/10W	-55 ~ +155	75V	150V	10Ω - 1MΩ				±100
					-	1.02MΩ - 10MΩ			±200
0805	1/8W	-55 ~ +155	150V	300V	10Ω - 1MΩ				±100
					-	1.02MΩ - 10MΩ			±200
1206	1/4W	-55 ~ +155	200V	400V	10Ω - 1MΩ				±100
					-	1.02MΩ - 10MΩ			±200
1210	1/3W	-55 ~ +155	200V	400V	10Ω - 1MΩ				±100
					-	1.02MΩ - 10MΩ			±200
2010	3/4W	-55 ~ +155	200V	400V	10Ω - 1MΩ				±100
					-	1.02MΩ - 10MΩ			±200
2512	1W	-55 ~ +155	250V	500V	10Ω - 1MΩ				±100
					-	1.02MΩ - 10MΩ			±200

TC50 Electrical Specifications

Table 4

Size	Power rating at 70°C	Operating temp. range °C	Max. Operating voltage	Max. overload voltage	Resistance range (E24 - E96)				TCR ppm/°C
					± 0.1%	± 0.25%	± 0.5%	± 1%	
0402	1/16W	-55 ~ +155	50V	100V	-	100Ω - 1MΩ			±50
0603	1/10W	-55 ~ +155	75V	150V	10Ω - 1MΩ	10Ω - 10MΩ			±50
0805	1/8W	-55 ~ +155	150V	300V	10Ω - 1MΩ	10Ω - 10MΩ			±50
1206	1/4W	-55 ~ +155	200V	400V	10Ω - 1MΩ	10Ω - 10MΩ			±50
1210	1/3W	-55 ~ +155	200V	400V	10Ω - 1MΩ	10Ω - 10MΩ			±50
2010	3/4W	-55 ~ +155	200V	400V	10Ω - 1MΩ	10Ω - 10MΩ			±50
2512	1W	-55 ~ +155	250V	500V	10Ω - 1MΩ	10Ω - 10MΩ			±50

High Power & Ultra High Power Rating Electrical Specifications

Table 5

Size	Power rating at 70°C Jumper rated current	Operating temp. range °C	Max. Operating voltage	Max. overload voltage	Resistance range			TCR ppm/°C
					±0.5% (E24 & E96)	±1% (E24 & E96)	± 5% (E24)	
0402	1/8W	-55 ~ +155	50V	100V	- 10Ω - 1MΩ -	1Ω - 9.76Ω 10Ω - 1MΩ -	1Ω - 9.76Ω 10Ω - 1MΩ 0Ω - (<20mΩ)	±200 ±100 -
	Jumper 1.5A							
0603	1/4W	-55 ~ +155	75V	150V				
	Jumper 2A							
0805	1/3W	-55 ~ +155	150V	300V				
	Jumper 2.5A							
1206	1/3W * 1/2W	-55 ~ +155	200V	400V				
	Jumper 3.5A							
1210	1/2W *3/4W	-55 ~ +155	200V	400V				
	Jumper 5A							
2010	1W	-55 ~ +155	200V	400V				
	Jumper 6A							
2512	2W	-55 ~ +155	250V	500V				
	Jumper 7A							

* Ultra High Power

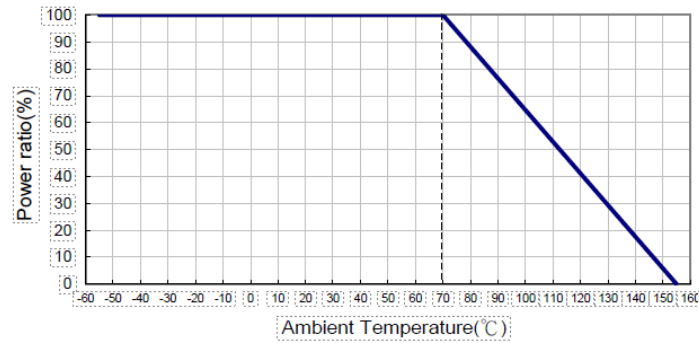
Operating Voltage = $\sqrt{(P \cdot R)}$ or Max. Operating Voltage listed above, whichever is lower.

Overload Voltage = $2.5 \cdot \sqrt{(P \cdot R)}$ or Max. Overload Voltage listed above, whichever is lower.

Capable of manufacturing the optional spec. based on customer's requirement.

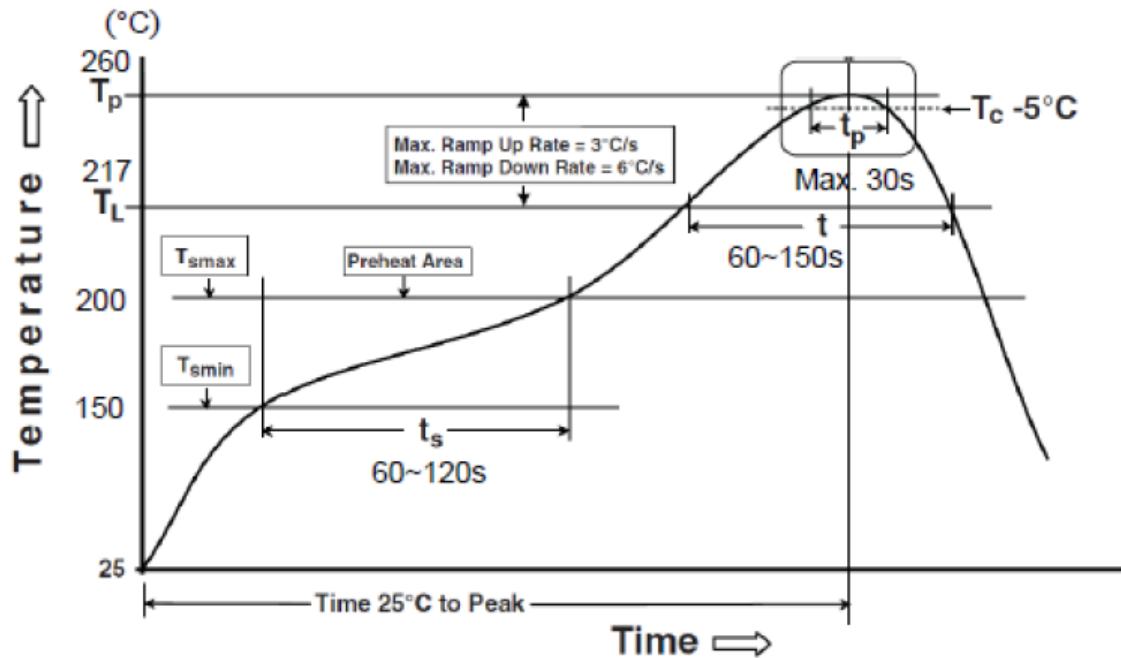
Derating Curve

Fig. 2



Soldering Condition (Ref. IPC/JEDEC J-STD-020 & J-STD-002)

Fig. 3



Reflow Profiles

Table 6

Profile Feature	Pb-Free Assembly
Preheat	
Min. Temperature (T_{smin})	150°C
Max Temperature (T_{smax})	200°C
Preheating time (t_s) from (T_{smin} to T_{smax})	60-120 seconds
Ramp-up rate (T_L to T_p)	3 °C/second max.
Liquidous temperature (T_L)	217 °C
Time (t_L) maintained above T_L	60-150 seconds
Min. Peak temperature (T_p min)	235°C
Max. Peak temperature (T_p max)	260°C
Time (t_p) within 5 °C of the specified classification temperature (T_c)	30 seconds max.
Ramp-down rate (T_p to T_L)	6 °C/second max.
Time 25 °C to peak temperature	8 minutes max.

Environmental Characteristics

Table 7

Item	Requirement			Test Method
	±1% and Below	±5%	Jumper	
Temperature Coefficient of Resistance (TCR)	As specification			JIS-C-5201-1 4.8 IEC-60115-1 4.8 At 25°C/-55°C & 25°C/+125°C, 25°C is the reference temperature
Short time overload	± (1.0%+0.05Ω)	± (2.0%+0.05Ω)	<50mΩ	JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWV*2.5 or max. overload voltage, whichever is lower for 5s, 2 seconds for high power series
Insulation resistance	≥10G			JIS-C-5201-1 4.6 IEC-60115-1 4.16 Max. overload voltage for 1 minute
Endurance	± (1.0%+0.10Ω)	± (2.0%+0.10Ω)	<100mΩ	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 70±2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF"
Damp Heat with Load	± (1.0%+0.10Ω)	± (2.0%+0.10Ω)	<100mΩ	JIS-C-5201-1 4.24 IEC-60115-1 4.24 40±2°C, 90~95% R.H., RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF"
Dry Heat	± (1.0%+0.05Ω)	± (1.5%+0.10Ω)	<50mΩ	JIS-C-5201-1 4.23 IEC-60115-1 4.23.2 At +155°C for 1000 hrs
Bending Strength	± (1.0%+0.05Ω)	± (1.0%+0.05Ω)	<50mΩ	JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending once for 60s 2010, 2512 sizes: 2mm Other sizes: 3mm
Solderability	95% min. coverage			JIS-C-5201-1 4.17 IEC-60115-1 4.17 245±5°C for 3 seconds
Resistance to Soldering Heat	± (0.5%+0.05Ω)	± (1.0%+0.05Ω)	<50mΩ	JIS-C-5201-1 4.18 IEC-60115-1 4.18 260±5°C for 10 seconds
Voltage Proof	No breakdown or flashover			JIS-C-5201-1 4.7 IEC-60115-1 4.7 1.42 times Max. operating voltage for 1 minute
Leaching	Individual leaching area ≤5% Total leaching area ≤10%			JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260±5°C for 30 seconds
Rapid Change of Temperature	± (0.5%+0.05Ω)	± (1.0%+0.05Ω)	<50mΩ	JIS-C-5201-1 4.19 IEC-60115-1 4.19 -55°C to +155°C, 5 Cycles

RCWV (Rated Continuous Working Voltage) = $\sqrt{P \cdot R}$ or Max. Operating Voltage whichever is lower.

Storage temperature : 15~28°C; Humidity < 80%RH

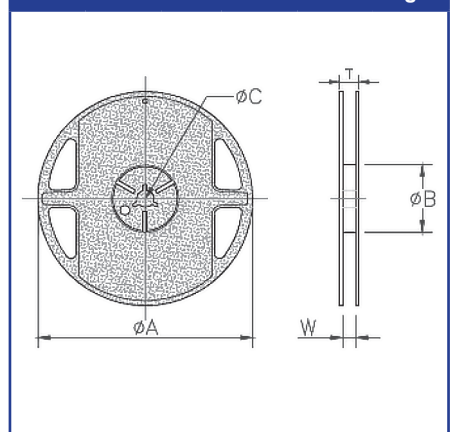
Shell life: 2 Years from production date.

Reel Specifications & Packaging Quantity

Table 8

Size	Packaging Quantity		Tape Width (mm)	Reel Ø (Inches)	Ø A (mm)	Ø B (mm)	Ø C (mm)	W (mm)	T (mm)
0201	Paper	15K	8	7	178.5±1.5	60.0+1/-0	13.0±0.2	9.0±0.5	12.5±0.5
0201 0402	Paper	10K	8	7	178.5±1.5	60.0+1/-0	13.0±0.2	9.0±0.5	12.5±0.5
		20K	8	10	254.0±1.0	100.0±0.5	13.0±0.2	9.5±0.5	13.5±0.5
		40K	8	13	330.0±1.0	100.0±0.5	13.0±0.2	9.5±0.5	13.5±0.5
		5K	8	7	178.5±1.5	60.0+1/-0	13.0±0.2	9.0±0.5	12.5±0.5
0603 0805 1206 1210	Paper	10K	8	10	254.0±1.0	100.0±0.5	13.0±0.2	9.5±0.5	13.5±0.5
		20K	8	13	330.0±1.0	100.0±0.5	13.0±0.2	9.5±0.5	13.5±0.5
		4K	12	7	178.5±1.5	60.0+1/-0	13.0±0.5	13.0±0.5	15.5±0.5
2010 2512	Embossed	8K	12	10	250 ±1.0	62.0±0.5	13.0±0.5	12.5±0.5	16.5±0.5

Fig. 4



Paper Tape Specifications

Fig. 5

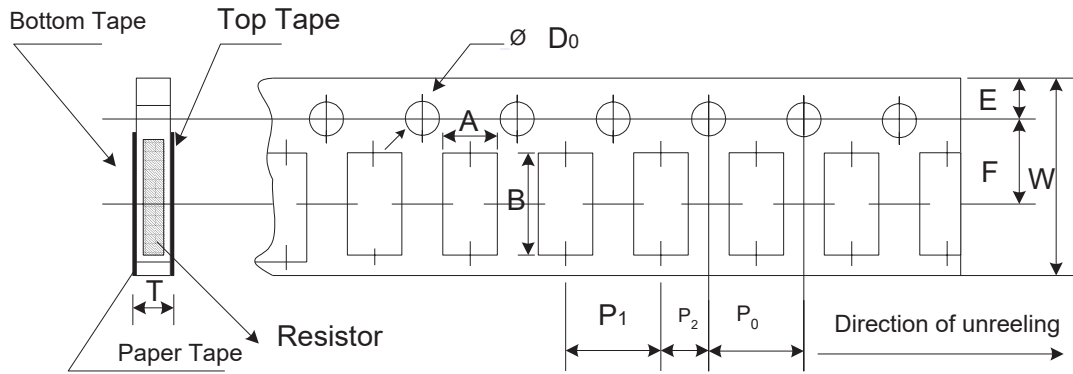
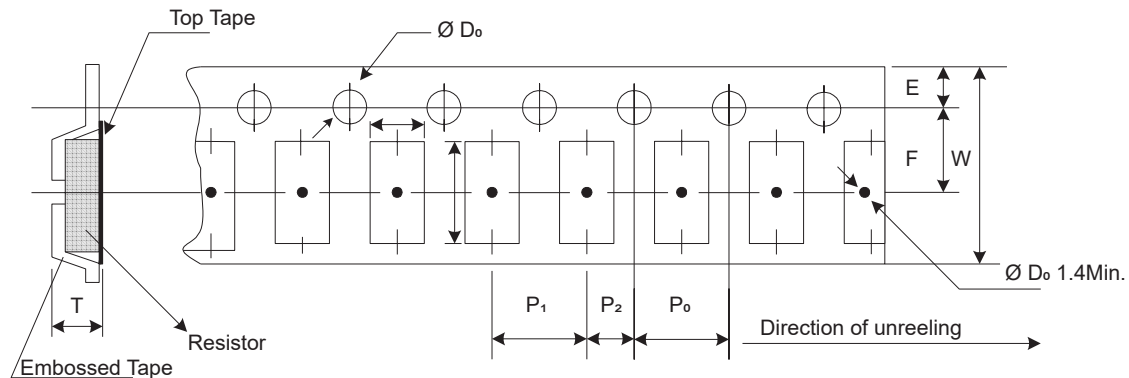


Table 9

Size	A	B	W	E	F	P ₀	P ₁	P ₂	ØD ₀	T
0201	0.38±0.05	0.68±0.05	8.00±0.20	1.75±0.10	3.50±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.50+0.1/-0	0.42±0.20
0402	0.65±0.10	1.15±0.10	8.00±0.20	1.75±0.10	3.50±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.50+0.1/-0	0.45±0.10
0603	1.10±0.10	1.90±0.10	8.00±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1/-0	0.70±0.10
0805	1.60±0.10	2.40±0.20	8.00±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1/-0	0.85±0.10
1206	1.90±0.10	3.50±0.20	8.00±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1/-0	0.85±0.10
1210	2.90±0.10	3.50±0.20	8.00±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1/-0	0.85±0.10

Emboss Plastic Tape Specifications

Fig. 6



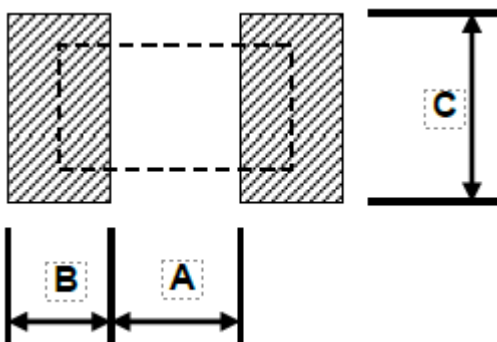
(mm)

Table 10

Size	A	B	W	E	F	P ₀	P ₁	P ₂	ØD ₀	T
2010	2.8±0.10	5.4±0.20	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1/-0	1.2+ ⁰
2512	3.5±0.10	6.7±0.10	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1/-0	1.2+ ⁰

Recommended Land Pattern

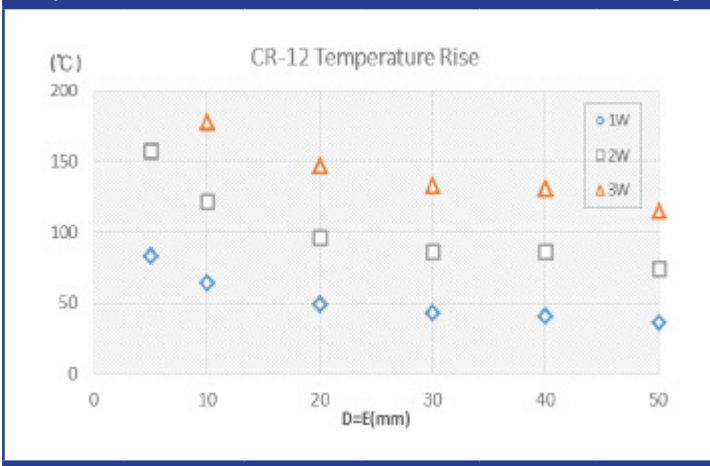
Table 11



Type	A (mm)	B (mm)	C (mm)
0201	0.30	0.25	0.30
0402	0.50	0.45	0.60
0603	0.90	0.60	0.90
0805	1.20	0.70	1.30
1206	2.00	0.90	1.60
1210	2.00	0.90	2.80
2010	3.80	0.90	2.80
2512	4.90	1.60	3.50

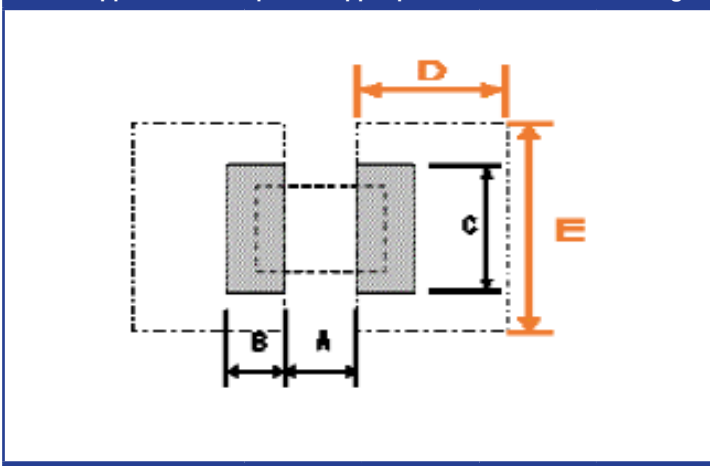
Temperature Rise

Fig. 7



* FR4 Copper Board - 35µm of copper pad thickness

Fig. 8



Marking

Table 12

No marking for 0201 and 0402

Jumper = '0' (zero)

1% for 0805 / 1206 / 1210 / 2010 / 2512: 4 Digit marking

Example							Table 10
Resistance	5.6 Ω	97.6 Ω	100 Ω	2.2K Ω	10K Ω	49.9K Ω	100K Ω
Marking	5R60	97R6	1000	2201	1002	4992	1003

5% for 0603 / 0805 / 1206 / 1210 / 2010 / 2512: 3 Digit marking in E24

Example

Table 13

101 = 100Ω 101 = 100Ω 102 = 1KΩ (1st and 2nd are E24 code and 3rd code is multiplier)

E24 Code	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
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1% for 0603 (E24): 3 Digits marking in E24, when the E24 and E96 are the same resistance, this marking in E96

01A = 100Ω 05C = 11KΩ 123 = 12KΩ 273 = 27KΩ

1% for 0603: 3 Digit marking in E96

3 Digit marking for example 14C = 13K7Ω 13C = 13K3Ω
68B = 4K99Ω 68X = 49.9Ω





Marking Table										Table 14	
Code	E96		Code	E96		Code	E96		Code	E96	
01	100		25	178		49	316		73	562	
02	102		26	182		50	324		74	576	
03	105		27	187		51	332		75	590	
04	107		28	191		52	340		76	604	
05	110		29	196		53	348		77	619	
06	113		30	200		54	357		78	634	
07	115		31	205		55	365		79	649	
08	118		32	210		56	374		80	665	
09	121		33	215		57	383		81	681	
10	124		34	221		58	392		82	698	
11	127		35	226		59	402		83	715	
12	130		36	232		60	412		84	732	
13	133		37	237		61	422		85	750	
14	137		38	243		62	432		86	768	
15	140		39	249		63	442		87	787	
16	143		40	255		64	453		88	806	
17	147		41	261		65	464		89	825	
18	150		42	267		66	475		90	845	
19	154		43	274		67	487		91	866	
20	158		44	280		68	499		92	887	
21	162		45	287		69	511		93	909	
22	165		46	294		70	523		94	931	
23	169		47	301		71	536		95	953	
24	174		48	309		72	549		96	976	
Code	A	B	C	D	E	F	G	X	Y		
Multiplier	10 ⁰	10 ¹	10 ²	10 ³	10 ⁴	10 ⁵	10 ⁶	10 ⁻¹	10 ⁻²		

Pulse withstanding capacity

Fig. 7

The limit of acceptance was a shift in resistance of less than 1% from the initial value. The power applied was subject to the restrictions of the maximum permissible impulse voltage.

CR Series Single Pulse

